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**Title 10 – DEPARTMENT OF NATURAL RESOURCES
Division 20 – Clean Water Commission
Chapter 8 – Design Guides**

10 CSR 20-8.150 Screening, Grit Removal, and Flow Equalization.

PURPOSE: This amendment will update the rule to current industry practices.

*PURPOSE: The following criteria have been prepared as a guide for the design of screening, grit removal and flow equalization facilities. This rule is to be used with rules 10 CSR 20-8.110[–] **through** 10 CSR 20-8.2[2]10 for the planning and design of the complete treatment facility. This rule reflects the minimum requirements of the Missouri Clean Water Commission [as] **in** regard[s] **to** adequacy of design, submission of plans, approval of plans, and approval of completed [sewage works] **wastewater treatment facilities. It is not reasonable or practical to include all aspects of design in these standards. The design engineer should obtain appropriate reference materials which include but are not limited to: copies of all ASTM International standards pertaining to wastewater screening, grit removal, flow equalization and appurtenances, design manuals such as Water Environment Federation's Manuals of Practice, and other wastewater treatment facility design manuals containing principles of accepted engineering practice.** Deviation from these minimum requirements will be allowed where sufficient documentation is presented to justify the deviation. These criteria are taken largely from **the 2014 edition of the** Great Lakes-Upper Mississippi River Board of State [Sanitary Engineers] **and Provincial Public Health and Environmental Managers Recommended Standards for [Sewage Works] Wastewater Facilities** and are based on the best information presently available. These criteria were originally filed as 10 CSR 20-8.030. It is anticipated that they will be subject to review and revision periodically as additional information and methods appear. [Addenda or supplements to this publication will be furnished to consulting engineers and city engineers. If others desire to receive addenda or supplements, please advise the Clean Water Commission so that names can be added to the mailing list.]*

(1) Definitions. Definitions as set forth in the Clean Water Law and 10 CSR 20-2.010 shall apply to those terms when used in this rule, unless the context clearly requires otherwise. Where the terms “shall” and “must” are used, they are to mean a mandatory requirement insofar as approval by the [agency] **Missouri Department of Natural Resources (department)** is concerned, unless justification is presented for deviation from the requirements. Other terms, such as “should”, “recommend”, “preferred” and the like, indicate *[discretionary requirements on the part of the agency and deviations are subject to individual consideration]* **the preference of the department for consideration by the design engineer.**

(A) Deviations. Deviations from these rules may be approved by the department when engineering justification satisfactory to the department is provided. Justification must substantially demonstrate in writing and through calculations that a variation(s) from

Comment [ETC1]: Should we change the title to “Preliminary Treatment” or “Headworks”?

TN – Keep as is.

CC – Preliminary Treatment

CL – Preliminary Treatment, but what about primary clarifiers?

LM – Preliminary Treatment or Headworks

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the design rules will result in either at least equivalent or improved effectiveness.

Deviations are subject to case-by-case review with individual project consideration.

(B) Comminutor. A comminutor is an instrument that cuts and shreds stringy materials and coarse solids into smaller sizes (approximately 0.25 to 0.75 inches).

(C) Fats, Oils, and Grease (FOG). Animal and plant derived substances that may solidify or become viscous between the temperatures of thirty-two and one hundred fifty degrees Fahrenheit (32 - 150°F), and that separates from wastewater by gravity.

(D) Flow Equalization. Flow equalization is a process of controlling flow rate variations to improve the performance of downstream processes and to reduce the size and cost of downstream treatment facilities.

(E) Grit. Grit includes sand, gravel, cinder, or other heavy solid materials that have a higher specific gravity than the organic biodegradable solids in the wastewater. Grit also includes eggshells, bone chips, seeds, coffee grounds, and large organic particles, such as food waste.

(F) Pump and Haul. Pump and haul systems temporarily holds domestic or industrial wastewater; the wastewater is then pumped down and hauled it to an appropriate wastewater treatment facility for ultimate disposal.

(G) Screening Device. A screening device physically removes inorganic objects from wastewater.

[(2) Exceptions. This rule shall not apply to facilities designed for twenty-two thousand five hundred (22,500) gallons per day (85.4m³) or less (see 10 CSR 20-8.020 for the requirements for those facilities).]

(2) General.

(A) A wastewater treatment facility must be designed with the ability to add provisions for removing fats, oils, and grease (FOG) from the wastewater.

(B) If fats, oils, or grease have caused operational failures in **an existing** treatment unit that is being **modified or replaced**, then FOG removal must be provided to prevent future failures.

(C) All wastewater treatment facilities must have a screening device, comminutor, or septic tank for the purpose of removing debris and nuisance materials from the influent wastewater.

(3) Screening Devices.

(A) General.

1. Design.

A. Flow distribution. Entrance channels should be designed to provide equal and uniform distribution of flow to the **screening devices**.

B. Flow measurement. Flow measurement devices should be selected for reliability and accuracy. The effect of changes in backwater elevation due to

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intermittent cleaning of **screening devices** should be considered in locations of flow measurement equipment. **See 10 CSR 20-8.140(8)(I) regarding flow measurement devices.**

C. Freeze protection. Screening devices and screening storage areas shall be protected from freezing.

D. Corrosion resistance. **Screening devices and related structures must be designed to resist the effects of a corrosive environment, including long-term exposure to hydrogen sulfide.**

2. Screenings removal and disposal.

A. A convenient and adequate means for removing screenings shall be provided.

Any screening device located in pits more than four feet (4') deep shall be provided with mechanical hoisting or lifting equipment capable of lifting the screenings to ground level.

B. Facilities shall be provided for handling, storage, and disposal of screenings in a **sanitary** manner **acceptable to the department**. Separate grinding of screenings and return to the wastewater flow is unacceptable.

C. Manually cleaned screening **devices** shall include an accessible platform from which **facility personnel** may rake screenings easily and safely. Suitable drainage facilities shall be provided for both the platform and the screenings storage area.

D. **Impervious, non-slip, working surfaces with adequate drainage shall be provided for screening handling areas.**

E. Screening transporting facilities shall be provided with protection against loss of material.

F. **Screenings must be disposed of at a frequency that prevents creation of a nuisance.** Odor control facilities may also be warranted.

3. Servicing.

A. Hosing equipment shall be provided to facilitate cleaning. **Refer to 10 CSR 20-8.140(8)(D) for wastewater treatment facility water supplies.**

B. Provisions shall be made for isolating or removing screening devices from their location for servicing. **See 10 CSR 20-8.140(6)(B) unit isolation for more information.**

4. Access. **Screening devices** located in pits more than four feet (4') deep **should consider providing** stairway access. Access ladders are acceptable for pits less than four feet (4') deep, in lieu of stairways.

5. Ventilation.

A. Screening devices, installed in a building where other equipment or offices are located, shall be isolated from the rest of the building **by an air-tight partition**, be provided with separate outside entrances, and be provided with separate and independent fresh air supply.

B. Fresh air shall be forced into enclosed screening device areas or open pits more than four feet (4') deep.

Comment [ETC2]: What is acceptable? Look at solid waste regulations.

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C. Dampers should not be used on exhaust or fresh air ducts. **Fine screens or other obstructions on exhaust or fresh air ducts** should be avoided to prevent clogging.

D. Where continuous ventilation is required, at least twelve (12) complete air changes per hour shall be provided. Where continuous ventilation would cause excessive heat loss, intermittent ventilation of at least thirty (30) complete air changes per hour shall be provided when **facility** personnel enter the area. The air change requirements shall be based on one hundred (100) percent fresh air.

E. Switches for operation of ventilation equipment **shall** be marked and conveniently located. All intermittently operated ventilation equipment shall be interconnected with the respective pit lighting system.

F. The fan wheel shall be fabricated from non-sparking material. Explosion proof gas detectors shall be provided in accordance with 10 CSR 20-8.140(9).

6. Safety.

A. Railings and gratings.

(I) Manually cleaned screen channels shall be protected by guard railings and deck gratings, with adequate provisions for removal or opening to facilitate raking.

(II) Mechanically cleaned screen channels shall be protected by guard railings and deck gratings. Consideration should also be given to temporary access arrangements to facilitate maintenance and repair.

(III) Also refer to 10 CSR 20-8.140(8)(G).

B. Mechanical devices.

(I) Mechanical screening equipment shall have adequate removal enclosures to protect **facility** personnel against accidental contact with moving parts and to prevent dripping in multi-level installations.

(II) A positive means of locking out each mechanical device shall be provided.

C. Drainage. Floor design and drainage shall be provided to prevent slippery areas.

D. Lighting. Suitable lighting shall be provided in all work and access areas. Refer to subparagraph (3)(A)7.B. of this rule.

7. Electrical equipment and control systems.

A. Timing devices. All mechanical units that are operated by timing devices shall be provided with auxiliary controls that will set the cleaning mechanism in operation at a preset high water elevation. If the cleaning mechanism fails to lower the high water, a warning should be signaled.

B. Electrical equipment, fixtures, and controls. Electrical equipment, fixtures, and controls in screening area where hazardous gases may accumulate shall meet the requirements of the National Electrical Code for Class I, Division 1, Group D locations.

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C. Manual override. Automatic controls shall be supplemented by a manual override.

[(A)](B) [Bar Racks and Screens.] Coarse Screens.

1. *[When]* **Where** required. Protection for pumps and other equipment shall be provided by *[either]* **trash racks**, coarse bar racks, or *[bar]* **coarse screens**. *[Protection for comminutors should be provided by coarse bar racks.]*

2. *Location.*

A. *Indoors. Screening devices, installed in a building where other equipment or offices are located, should be accessible only through a separate outside entrance.*

B. *Outdoors. Screening devices installed outside shall be protected from freezing.*

C. *Access. Screening areas shall be provided with stairway access, adequate lighting and ventilation and a convenient and adequate means for removing the screenings.]*

3. **2. Design [and installation].**

A. *Bar spacing.*

(I) Manually cleaned. Clear openings between bars should be *[no less than]* **from** one *[inch (1") (2.54 cm)]* **to three inches (1 – 3")** for manually cleaned screens.

(II) Mechanically cleaned. Clear openings for mechanically cleaned screens may be *[as]* smaller *[as five-eighths of an inch (5/8") (1.50 cm)]* **than one inch (1")**. Maximum clear openings should be one and three-fourths inches (1 3/4") *[(4.45 cm)]*.

B. *Slope. Manually cleaned screens, except those for emergency use, should be placed on a slope of thirty to forty-five degrees (30°–45°) [on] from the horizontal.*

C. *Velocities. At [normal operating] design average flow conditions, approach velocities should be no less than 1.25 feet per second [(38.1 cm/sec)], to prevent settling; and no greater than three (3.0) feet per second [fps (91.4 cm/sec)] at peak hourly flows* to prevent forcing material through the openings.

D. *Channels. Dual channels shall be provided and equipped with the necessary gates to isolate flow from any screening unit. Provisions shall [also] be made to facilitate de[-]watering each [unit] channel. The channel preceding and following the screen shall be shaped to eliminate stranding and settling of solids.*

E. Auxiliary screens. Where a single mechanically cleaned screen is used, an auxiliary manually cleaned screen shall be provided. Where two (2) or more mechanically cleaned screens are used, the design shall provide for taking any unit out-of-service without sacrificing the capability to handle the design peak instantaneous flow.

[E.]F. Invert. The screen channel invert should be three to six inches (3"–6") [(7.6–15.2 cm)] below the invert of the incoming sewer. To prevent jetting action, the length and construction of the channel shall be adequate to reestablish the hydraulic flow pattern following the drop in elevation.

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[F. Flow distribution. Entrance channels should be designed to provide equal and uniform distribution of flow to the screens.

G. Flow measurement. Flow measurement devices should be selected for reliability and accuracy. The effect of changes in backwater elevations, due to intermittent cleaning of screens, should be considered in locations of flow measurement equipment.]

[4. Safety.

A. Railings and gratings. Manually cleaned screen channels shall be protected by guard railings and deck gratings, with adequate provisions for removal or opening to facilitate raking. Mechanically cleaned screen channels shall be protected by guard railings and deck gratings. Consideration should also be given to temporary access arrangements to facilitate maintenance and repair.

B. Mechanical devices. Mechanical screening equipment shall have adequate removal enclosures to protect personnel against accidental contact with moving parts and to prevent dripping in multi-level installations. A positive means of locking out each mechanical device shall be provided.

5. Control systems.

A. Timing devices. All mechanical units which are operated by timing devices shall be provided with auxiliary controls which will set the cleaning mechanism in operation at a pre-set high water elevation.

B. Electrical fixtures and controls. Electrical fixtures, and controls in screening areas where hazardous gases may accumulate shall be suitable for hazardous locations (National Electrical Code, Class I, Group D, Division 1 location).

C. Manual override. Automatic controls shall be supplemented by a manual override.

6. Disposal of screenings. Facilities must be provided for removal, handling, storage and disposal of screenings in a sanitary manner. Separate grinding of screenings and return to the sewage flow is unacceptable. Manually cleaned screening facilities should include an accessible platform from which the operator may rake screenings easily and safely. Suitable drainage facilities shall be provided for both the platform and storage areas.

7. Auxiliary screens. Where a single mechanically cleaned screen is used, an auxiliary manually cleaned screen shall be provided. Where two (2) or more mechanically cleaned screens are used, the design shall provide for taking any unit out-of-service without sacrificing the capability to handle the peak design flow.]

[(B)](C) Fine Screens.

1. General.

A. Fine screens, as discussed in this subsection, have openings of approximately one quarter inch (1/4"). The amount of material removed by fine screens is dependent on the waste stream being treated and screen opening size.

B. Fine screens should not be considered equivalent to primary sedimentation. However, [F]fine screens may be used in lieu of primary sedimentation [providing that] where subsequent treatment units are designed on the basis of anticipated screen

Comment [ETC3]: 10 States had 1/16". During our last stakeholder meeting it was discussed that 1/16" was too small. Should we consider a range (e.g. 1/16 – 1/4")?

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performance. *[Fine screens should not be considered equivalent to primary sedimentation.]* **Selection of screen capacity should consider flow restriction due to retained solids, adhesive materials, frequency of cleaning, and extent of cleaning.** Where fine screens are used, additional provisions for the removal of *[floatable oils and greases]* **FOG** shall be considered.

2. Design. *[Tests should be conducted to determine BOD₅ and suspended solids removal efficiencies at the design peak hydraulic and peak organic loadings.]*

A. A minimum of two (2) fine screens shall be provided[;] **with** each unit being capable of independent operation. Capacity shall be provided to treat **design** peak *[design]* **instantaneous** flow[s] with one (1) unit out-of-service.

B. Fine screens shall be preceded by a *[mechanically cleaned bar screen or other protective]* **coarse screening** device. *[Comminuting devices shall not be used ahead of fine screens.]*

C. **A moving or rotating fine screen must use a continuous cleaning device, such as water jets or wiper blades.**

D. **A fine screen unit must automatically convey the screenings to a storage area or processing unit.**

E. **A fine screen must meet the manufacturer's recommendations with respect to velocity and head loss through the fine screen.**

[3. Electrical fixtures, and controls. Electrical fixtures, and controls in screening areas where hazardous gases may accumulate shall be suitable for hazardous locations (National Electrical Code, Class I, Group D, Division 1 location).]

4. Servicing. *Hosing equipment shall be provided to facilitate cleaning. Provisions shall be made for isolating or removing units from their location for servicing.]*

3. **Organic removal credit. Any BOD₅ and suspended solids reduction percentage claimed for a fine screen must be developed through a pilot study conducted on actual full-scale operation of the proposed fine screen at the design maximum day flow and design maximum day organic loadings. Pilot testing for an extended time is preferred to cover seasonal operational variations.**

A. **The BOD₅ reduction percentage claimed must not exceed thirty-five percent (35%).**

B. **The facility plan must justify any reduction in the size of the treatment unit that is based on organic removal by a fine screen.**

C. **A wastewater treatment facility claiming an organic reduction credit must include a sufficient number of fine screen units so that any organic reduction claimed will be met with the largest fine screen out-of-service.**

D. **No organic removal credit shall be allowed with a single fine screen design.**

(D) Microscreens. Wastewater treatment facilities proposing microscreens for preliminary treatment shall be evaluated on a case-by-case basis. Refer to 10 CSR 20-8.210(5).

1. **Microscreens have openings of less than one millimeter (1 mm).**

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2. Microscreens shall be located downstream of grit removal equipment and be protected by a coarse screening device at a minimum.

(4) Comminutors.

(A) General. Provisions for *[location]* **access, ventilation, and safety** shall be in accordance with *[screening devices,]* paragraphs (3)(A)/2/4. **through (3)(A)6.** of this rule.

[(B) When Required. Comminutors shall be used in plants that do not have primary sedimentation or fine screens and should be provided in cases where mechanically cleaned bar screens will not be used.]

(B) When Used. Comminutors may be used in lieu of screening devices to protect equipment where stringy substance accumulation on downstream equipment will not be a substantial problem.

(C) Design Considerations.

1. Location.

A. Comminutors should be located downstream of *[any]* grit removal equipment **and be protected by a coarse screening device.**

B. Comminutors not preceded by grit removal equipment shall be protected by a six inch (6") deep gravel trap.

2. Size. Comminutor capacity shall be adequate to handle **design** peak **hourly** flow[*s*].

3. Installation.

A. A screened bypass channel shall be provided. The use of the bypass channel should be automatic *[at depths of flow exceeding the design capacity for the comminutor]* **for all comminutor failures and at depths of flow exceeding the design capacity for the comminutor.** *[Each comminutor that is not preceded by grit removal equipment should be protected by a six inch (6.0") (15.2 cm) deep gravel trap.]*

B. Gates shall be provided in accordance with subparagraphs (3)(A)/3/2.D. **through (3)(A)2.E.** of this rule.

4. Servicing. Provisions shall be made to facilitate servicing units in place and **to** remov[*ing*]**e** units from their location for servicing.

5. Electrical controls and motors. Electrical equipment in comminutor chambers where hazardous gases may accumulate shall *[be suitable for hazardous locations (]* **meet the requirements of the National Electrical Code[,]** **for Class I, [Group D,]** Division 1, **Group D** location[*)]*s. Motors *[in areas not governed by this requirement may need protection]* **shall be protected** against accidental submergence.

(5) Grit Removal Facilities.

(A) When Required.

1. Wastewater treatment facilities using, membrane bioreactors for secondary treatment, anaerobic digestion, and *[Grit removal facilities should be provided for all sewage treatment plants; and are required for plants]* **facilities** receiving *[sewage]*

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wastewater from **either** combined sewers or from sewer systems receiving substantial amounts of grit **must have grit removal facilities**.

2. Grit removal facilities should be provided for all wastewater treatment facilities.

If a *[plant]* **wastewater treatment facility** serving a separate sewer system is designed without grit **removal** facilities, the design shall include provisions for future installation. Consideration shall be given to possible damaging effects on pumps, comminutors, and other preceding equipment, and the need for additional storage capacity in treatment units where grit is likely to accumulate.

(B) Location.

1. General. Grit removal facilities should be located ahead of pumps and comminuting devices. Coarse *[bar racks]* **screening devices** should be placed ahead of grit removal facilities.

2. Housed facilities.

A. Ventilation. **Refer to paragraph (3)(A)5. of this rule.** *[Uncontaminated]* **Fresh** air shall be introduced continuously at a rate of **at least** twelve (12) air changes per hour, or intermittently at a rate of **at least** thirty (30) air changes per hour. Odor control facilities may also be warranted.

B. Access. Adequate stairway access to above or below grade facilities shall be provided. **Refer to paragraph (3)(A)4. of this rule.**

C. Electrical. *[All electrical work]* **Electrical equipment** in enclosed grit removal areas where hazardous gases may accumulate shall *[be suitable for hazardous locations (] meet the requirements of the National Electrical Code[,]* **for Class I, [Group D,] Division 1, Group D location[)]s. Explosion proof gas detectors shall be provided in accordance with 10 CSR 20-8.140(9).**

3. Outside facilities. Grit removal facilities located outside shall be protected from freezing.

(C) Size. Grit removal facilities with fixed capacity shall meet the design peak hourly flow.

[(C)](D) [Type and] Number of Units.

1. *[Plants]* **Wastewater treatment facilities** treating wastes from combined sewers should have at least two (2) mechanically cleaned grit removal units, with provisions for bypassing.

2. A single manually cleaned or mechanically cleaned grit chamber with bypass is acceptable for *[small]* *[sewage]* **wastewater treatment [plants] facilities** serving separate sanitary sewer systems.

3. *[Minimum f]* Facilities for *[larger]* *[plants]* **wastewater treatment facilities** serving separate sanitary sewers should *[be]* **have** at least one (1) mechanically cleaned unit with a bypass.

(E) Grit Chamber Types. Facilities other than channel-type *[are acceptable if]* **shall be** provided with adequate and flexible controls for *[agitation]* **velocity** and/or air supply devices and with grit collection and removal equipment.

Comment [ETC4]: Should we add a flow value?

Comment [ETC5]: Should we add a flow value?

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1. **Channel-type grit chambers.**
 - A. Velocity must range from 0.8 feet per second to not more than 1.3 feet per second.
 - B. The channel must minimize turbulence and provide uniform velocity across the channel.
 - C. The channel size must accommodate the grit removal equipment capacity and grit storage.
2. **Aerated grit chambers.**
 - A. Aerated grit chambers should have air rates adjustable in the range of three to eight (3 – 8) cubic feet per minute per foot of tank length.
 - B. Detention time in the tank should be in the range of three to five (3 – 5) minutes at design peak hourly flows.
 - C. The grit hopper **must be** located under an air diffuser.
3. **Mechanical grit chambers.**
 - A. The velocity must be no greater than one (1) foot per second at design **average** flow.
 - B. Each channel must include a grit hopper at the side of a tank contiguous to a grit removal mechanism.
 - C. An inlet must include baffles to prevent short-circuiting.
 - D. Grit removal must be provided by one (1) of the following mechanisms:
 - (I) Reciprocating rake;
 - (II) Screw conveyor; or
 - (III) Air lift pump.
4. **Cyclonic **grit chambers.****
 - A. A cyclonic grit chamber must prevent an inlet-to-outlet short circuit.
 - B. A cyclonic grit chamber must include an adjustable apex with a quick disconnect assembly to remove any oversized object.
 - C. Detention time must be at least one (1) minute at the design **average** flow.
 - D. The flow velocity must be at least one (1) foot per second but not more than two (2) feet per second at design **average** flow.
 - E. A screening device must be installed upstream of a cyclonic grit chamber.
5. **Vortex grit chamber.**
 - A. An inlet channel must include a straight length in order to deliver smooth flow into the vortex grit chamber. **The length of the inlet channel must be at least seven (7) times the width or fifteen feet (15'), whichever is greater.**
 - B. **Detention time must be at least thirty (30) seconds at the design average flow.**
 - C. The inlet velocity must be at least two (2) feet per second at peak flow.
 - D. **Provide a propeller with a variable speed drive to operate the unit based upon the wastewater treatment facility flow.**
 - E. An outlet channel must maintain a constant elevation.
 - F. **Provide air or water scour to loosen compacted grit and facilitate the grit**

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lifting and removal from the chamber.

G. Grit removal from a grit storage chamber must be achieved using pumps specifically designed to handle grit. Air lift pumps shall not be used for this purpose.

*[(D)]***(F)** Design Factors.

1. General. The design effectiveness of a grit removal system shall be commensurate with the requirements of the subsequent process units.

2. Inlet. Inlet turbulence shall be minimized **in channel-type chambers.**

3. Velocity and detention. Channel-type chambers shall be designed to control velocities during normal variations in flow as close as possible to one foot (1') per second *[(30 cm/sec)]*. The detention period shall be based on the size of particle to be removed. All **aerated** grit removal facilities should be provided with adequate *[automatic]* control devices to regulate *[detention time, agitation or]* air supply **and agitation.**

4. Grit washing. The need for grit washing should be determined by the method of **grit handling and final [grit] disposal.**

5. *[Drains]***Dewatering.** Provisions shall be made for isolating and de[-]watering each unit. **The design shall provide for complete draining and cleaning by means of a sloped bottom equipped with a drain sump.**

6. Water. An adequate supply of water under pressure shall be provided for cleanup.

Refer to 10 CSR 20-8.140(8)(D) for wastewater treatment facility water supplies.

[7. Grit handling. Grit removal facilities located in deep pits should be provided with mechanical equipment for hoisting or transporting grit to ground level. Impervious, non-slip, working surfaces with adequate drainage shall be provided for grit handling areas. Grit transporting facilities shall be provided with protection against freezing and loss of material.]

(G) Grit Handling and Disposal. Provisions for grit handling and disposal shall be in accordance with paragraph (3)(A)2. of this rule.

(H) Safety. Provisions for safety shall be in accordance with paragraph (3)(A)2. of this rule.

(6) Preaeration. Pre[-]aeration of *[sewage]* **wastewater** *[to reduce septicity]* may be required *[in special cases]* **to reduce septicity, separate grease, promote uniform distribution of solids to clarifiers, or as an odor control measure.**

(A) Pre-aeration unit operations shall be designed so that removal from service will not interfere with normal downstream operation of the remainder of the treatment facility.

(B) Inlet and outlet devices shall be designed to ensure proper distribution and help prevent solids deposition, while minimizing any hydraulic short circuiting effects.

(C) The aeration equipment should be capable of obtaining both adequate mixing and self-cleaning velocities within the basin.

(D) A satisfactory means of grit removal shall be provided for operation of preaeration basins.

LEGEND:

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(7) **Diurnal** Flow Equalization.

[(A) General. Flow equalization can reduce the dry weather variations in organic and hydraulic loadings at any wastewater treatment plant. It should be provided where large diurnal variations are expected.]

(A) Where Required.

1. The use of flow equalization should be considered where significant variations in organic and hydraulic loadings are expected, **where peak to average is greater than three to one (3:1)**. See also 10 CSR 20-8.140(5)(D)4.

2. Flow equalization shall be provided ahead of sequencing batch reactors or other batch discharging treatment facilities. See also **10 CSR 20-8.180(?)**.

3. Flow equalization shall be provided at all wastewater treatment facilities utilizing a wet weather flow equalization basin.

4. Flow equalization shall be provided ahead of biological treatment facilities that are permitted with effluent limitations less than twenty (20) milligrams per liter of BOD₅ or total suspended solids, or a total kjeldahl nitrogen of less than five milligrams per liter, or a total phosphorus of less than two (2) milligrams per liter; unless, engineering analysis shows that absence of flow equalization is more cost effective while maintaining the same degree of reliability and operational control.

(B) Location. Equalization basins should be located downstream of pretreatment facilities such as *[bar screens]* **screening devices**, comminutors, and grit *[chambers]* **removal facilities**.

(C) Type. Flow equalization can be provided by using separate basins or on-line treatment units, such as aeration tanks. Equalization basins may be designed as either in-line or side-line units. **If a wastewater treatment facility has an actual flow of thirty percent (30%) or less of the design average flow, [U]nused** treatment units, such as sedimentation or aeration tanks, may be utilized as equalization basins *[during the early period of design life]*.

(D) Size. Equalization basin capacity should be sufficient to effectively reduce expected flow and load variations to the extent deemed to be economically advantageous. With a diurnal flow pattern, the volume required to achieve the desired degree of equalization can be determined from a cumulative flow plot over the representative twenty-four (24)-hour period.

(E) Operation.

1. Mixing. Aeration or mechanical equipment shall be provided to maintain adequate mixing. Corner fillets and hopper bottoms with draw-offs should be provided to alleviate the accumulation of sludge and grit.

2. Aeration. Aeration equipment shall be sufficient to maintain a minimum of **one milligram per liter** (1.0 mg/l) of dissolved oxygen in the mixed basin contents at all times. Air supply rates should be a minimum of 1.25 *[cfm]* **cubic feet per minute** per one thousand **(1,000)** gallons *[(1000 gal) (9 l/min/m³)]* of storage capacity. The air supply should be isolated from other treatment *[plant]* **facility** aeration requirements to facilitate process aeration control. *Standard process aeration*, **although process air supply**

Comment [ETC6]: Add citation for SBRs.

Comment [ETC7]: This eliminates utilizing a wet weather flow equalization basin on a regular basis and holding water. It would also give the wet weather flow equalization basin a ready place to return flow.

Comment [ETC8]: Changed from design life to a percent of the design flow. An upgraded WWTF (ex. lagoon to mechanical plant) could be near 80% of its design flow, but still in the nearly period of design life.

Is 30% acceptable or should another value be used?

What is considered early design life – 5 years?

Comment [ETC9]: End of our discussions on 3/29/16.

LEGEND:

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equipment may be utilized as a source of standby aeration.

3. Multiple mixing and aeration units shall be provided for continuous operability.

3.4. Controls. Inlets and outlets for all basin compartments shall be suitably equipped with accessible external valves, stop plates, weirs, or other devices to permit flow control and the removal of an individual unit from service. Facilities shall also be provided to measure and indicate liquid levels and flow rates **leaving the basin.**

5. For pumped flow to an equalization basin, the effluent from the basin must be controlled by a flow-regulating device capable of maintaining a flow rate that allows downstream process units to operate as designed.

6. For pumped flow from an equalization basin, a variable-speed pump or multiple pumps are required to deliver a constant flow to downstream treatment units.

(F) Construction Materials. Type of construction materials may be earthen, concrete, or steel basins. See 10 CSR 20-8.200(5)(D)5. for earthen basin construction requirements.

(G) Number of Basins. Flow equalization basins with a storage capacity exceeding twenty thousand (20,000) gallons should be constructed as compartmentalized or as multiple basins. The storage basins shall be provided with a means to be dewatered.

[(F)](H) Electrical. All electrical work in housed equalization basins, *[shall be suitable for hazardous locations (]where hazardous concentrations of flammable gases or vapors may accumulate, shall meet the requirements of the National Electrical Code[,]* for Class I, *[Group D,]* Division 1, **Group D** location~~)]~~s.

[(G)](I) Access. Suitable access shall be provided to facilitate *[the]* cleaning and the maintenance of equipment *[and cleaning]*.

Comment [ETC10]: Should we include a minimum number of units?

Comment [ETC11]: Should we add a requirement for a gravity bypass in case of excessive flows, power outage, etc.?

Comment [ETC12]: Are there other instances where wet weather flow equalization should be required or recommended? Is the 6:1 acceptable?

(8) Wet Weather Flow Equalization.

(A) Where Required. The use of wet weather flow equalization should be considered where significant variations in organic and hydraulic loadings are expected, where peak to average is greater than six to one (6:1).

(B) Basin Type.

1. For gravity inlet systems, provide flow splitting or automated flow diversion devices to divert excess flows to the flow equalization basin(s). Design shall include a method to return contents to the headworks.

2. For pumped systems, installation of control valves or dedicated pumps to handle wet weather flow shall be used to divert wet weather flow to the basin.

3. Depending on the elevation of the basin, it may be possible to return the flow to the wastewater treatment facility's headworks by gravity. If not, a pump return system shall be required.

(C) Design. The design of basins requires a thorough evaluation of flow patterns and volumes. Items to be considered are basin geometry, construction materials, storage capacity and operational controls.

(D) Construction. Type of construction may be earthen, concrete, or steel basins. See 10 CSR 20-8.200(5)(D)6. for earthen basin construction requirements.

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(E) Basin Layout.

1. Basins designed for storage of five (5) million gallons or more require a minimum of two (2) compartments designed to operate in series. All flow must be diverted to a basin where solids can settle and, at a predetermined elevation, overflow to additional basins.
2. A single basin equipped with an impervious liner is acceptable where the required storage capacity is less than five (5) million gallons.
3. Provisions shall be required for returning the contents of the basins to the diurnal flow equalization basin and for removal of settled solids.

(F) Storage Capacity. Design minimum storage to contain the anticipated excess flow during the largest seven (7)-day wet weather period in ten (10) years, with the capability to be emptied in a timely manner. Actual flow data, based on no less than one (1) year of influent flow data, shall be used to develop flow balance or mass diagrams for determining basin capacity. Base the frequency and duration of storms on field data and weather service records.

(G) Aeration Requirements. Where oxygen is required to prevent the wastewater from becoming anaerobic, provide air at the rate of 1.25 to two (2) cubic feet per minute per one thousand (1,000) gallons basin volume.

(H) Pumps and Flow Control Methods. Controls are required to regulate flow to the basin and return flow to the diurnal flow equalization basin.

1. Adequate controls with measuring devices are required to divert all flow in excess of the treatment facility's hydraulic capacity to the basin.
2. Provisions and controls are required to return the basin contents to the diurnal flow equalization basin after the wet weather event has passed and influent flow returned to normal.
3. Return flow may be manual or automatic, but sufficient flow measurement and instrumentation devices must be included to determine the actual flow to the diurnal flow equalization basin.
4. Where basin return flow is automatic, control equipment must limit the combination of influent flow plus the basin return flow to the hydraulic capacity of the diurnal flow equalization basin.

(9) Grease Interceptors. Grease interceptors shall be provided on kitchen drain lines from institutions, hotels, restaurants, school lunch rooms, and other establishments from which relatively large amounts of grease may be discharged to the wastewater treatment facility.

(A) Grease interceptors should be located as close to the fixtures being served as possible and should receive only the waste streams from grease-producing fixtures. Sanitary waste streams, garbage grinder waste streams, and other waste streams which do not include grease should be excluded from passing through the grease traps. Grease interceptors must be cleaned on a regular basis and must be readily accessible for this purpose.

Comment [ETC13]: Is this needed? How often is this regulation utilized?

Department of Insurance, Financial Institutions and Professional Registration - 20 CSR 2030-2.040 Evaluation Criteria for Building Design: "For building design, the board shall use, in the absence of any local building code, the 2015 edition of the International Building Code, as the evaluation criteria in determining the appropriate conduct for any professional licensed or regulated by this chapter and being evaluated under section 327.441.2(5), RSMo."

Would this information be better suited to a Fact Sheet with links to other resources?

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(B) Sizing of grease **interceptors** is based on wastewater flow and can be calculated from the number and kind of sinks and fixtures discharging to the **interceptor**. In addition, a grease **interceptor** should be rated on its retention capacity, which is the amount of grease (in pounds) that the **interceptor** can hold before its average efficiency drops below ninety percent (90%). Current practice is that grease-retention capacity in pounds should equal at least twice the flow capacity in gallons per minute. The following two (2) equations may be used to determine the capacity of grease **interceptors** for restaurants and other types of commercial facilities:

1. Restaurants.

Size of grease **interceptor** in gallons = $D \times GI \times Sc \times Hr/2 \times Lf$

Where:

D = Number of seats in dining area;

GI = Gallons of wastewater per meal, normally five (5) gallons;

Sc = Storage capacity factor, minimum of 1.7;

Hr = Number of hours open; and

Lf = Loading factor:

1.25 interstate highways

1.0 other freeways

1.0 recreational areas

0.8 main highways

0.5 other highways.

2. Hospitals, nursing homes, other type commercial kitchens with varied seating capacity.

Size of grease **interceptor** in gallons = $M \times GI \times Sc \times 2.5 \times Lf$

Where:

M = Meals per day;

GI = Gallons of wastewater per meal, normally 4.5;

Sc = Storage capacity factor, minimum of 1.7; and

Lf = Loading factor:

1.25 garbage disposal and dishwashing

1.0 without garbage disposal

0.75 without dishwashing

0.5 without dishwashing and garbage disposal.

(C) Grease **interceptors** shall be provided with a manhole or opening of sufficient size to permit inspection and cleaning. When the grease **interceptor** is located below ground, the access opening shall be extended to grade. The opening shall be fitted with a tight fitting cover which will prevent the entrance of insects and vermin **and stormwater**.

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(D) The grease **interceptor should be constructed of materials similar to septic tanks and be properly baffled on both the inlet and outlet.**

(10) Septic Tanks. Septic tanks may be accepted as a satisfactory means of primary treatment for installations receiving flows not in excess of twenty-two thousand five hundred (22,500) gallons per day.

(A) Size. The capacity of the septic tank should be determined based on the design average flow of the facility. A septic tank must have a minimum capacity of at least one thousand (1,000) gallons. Twenty percent (20%) of the septic tank capacity should be provided for freeboard and ventilation.

(B) Construction materials.

1. Septic tanks are typically constructed from fiberglass reinforced polyester, high density polyethylene, or concrete.

2. All pipes and appurtenances within a septic tank must be corrosion resistant. For metal components, austenitic stainless steel of type 316 or 304 shall be provided at a minimum. Nylon is degraded by hydrogen sulfide and is not acceptable.

3. Contact between dissimilar metals should be avoided or other provisions made to minimize galvanic action.

(C) Septic tanks shall be watertight.

(D) Access. A minimum access diameter of twenty-four inches (24") shall be provided to service the tank. Bolt-down cover assemblies or locked covers shall be provided.

(E) Baffles. The septic tank shall be baffled. The baffle wall shall have a minimum three inch (3") air gap from the lid of the septic tank for ventilation.

(F) Corrosion protection. Corrosion protection on the interior of the septic tank shall be provided. All pipes within a septic tank must be corrosion resistant.

(G) Inlet and outlet tees. Inlet and outlet tees shall be provided to maximize removal and retention of solids within the septic tank.

(H) Ventilation. Septic tanks must be ventilated.

(I) Outlet screen. The septic tank outlet shall have an effluent screen to reduce large solids from the sewers.

(J) Location. Septic tanks shall be buried with access risers at or above grade. The location should consider future maintenance and removal of accumulated solids accessibility.

(11) Pump and Haul. Pump and haul systems are not to be used in lieu of traditional onsite wastewater treatment facilities or connection to a collection system operated and maintained by one (1) of the continuing authorities listed in 10 CSR 20-6.010(3)(B). Pump and haul systems shall be reviewed and approved by the department on a case-by-case basis.

(A) General.

Comment [ETC14]: Is this section more relevant in 10 CSR 20-8.140 or in 8.150?

Comment [ETC15]: Should we also add setback distances?

LEGEND:

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1. Accessibility. Pump and haul systems shall be readily accessible by maintenance vehicles during all weather conditions. Pump and haul systems should be located off the traffic way of streets and alleys. Also refer to 10 CSR 20-8.140(3)(D).
2. Security. It is recommended that electrical control panels with locks be provided. Also refer to 10 CSR 20-8.140(9)(A)1. for fencing requirements.
3. Buoyancy. Where high groundwater conditions are anticipated, buoyancy of the piping and wastewater structures shall be considered and, if necessary, adequate provisions shall be made for protection.
4. Protection of Water Supplies. The relation and crossings of water supplies shall be in accordance with 10 CSR 20-8.120(10).

(B) Contracts and Agreements.

1. The applicant shall provide a written contract with a hauler company, which will dispose of the wastewater at a permitted wastewater treatment facility.
2. The applicant shall provide a written agreement from the receiving wastewater treatment facility accepting the wastewater for ultimate disposal.

(C) Septic Tank Design.

1. Capacity. The capacity of the septic tank should be determined based on the design average flow of the facility and the frequency of pumping down the tank. Twenty percent (20%) of the septic tank capacity should be provided for freeboard and ventilation.
2. Frequency of pumping. The tank must be pumped at a frequency that prevents creation of a nuisance. Odor control facilities may also be warranted.
3. Construction materials. Septic tanks are typically constructed from fiberglass reinforced polyester, high density polyethylene, or concrete.
4. Septic tanks shall be watertight.
5. Access. A minimum access diameter of twenty-four inches (24") shall be provided to service the tank. Bolt-down cover assemblies or locked covers shall be provided.
6. Baffles. The septic tank shall be baffled. The baffle wall shall have a minimum three inch (3") air gap from the lid of the septic tank for ventilation.
7. Corrosion protection. Corrosion protection on the interior of the septic tank shall be provided. All pipes within a septic tank must be corrosion resistant.
8. Inlet tees. Inlet tees shall be provided to maximize removal and retention of solids within the septic tank.
9. Ventilation. Septic tanks must be ventilated. Typical ventilation is through the plumbing stack of the structure it is serving.

(D) Earthen Basin Design. Refer to 10 CSR 20-8.200(?).

(E) Controls. Water level control sensing device should be located to prevent undue affects from turbulent flows entering the septic tank or earthen basin. Water level controls must be accessible without entering the septic tank or earthen basin.

(F) Alarm system. Alarm system with a backup power source shall be provided for pump and haul systems. The alarm shall be activated in cases of high water levels.

Comment [ETC16]: Should these contracts/agreements be for a certain length of time?
Example: 5 years?

Comment [ETC17]: Is this portion necessary?

Comment [ETC18]: Is this portion necessary?

Comment [ETC19]: Which section of the 8.200 should be cited?

Comment [ETC20]: Should we specify the freeboard level below the lid or berm?

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Audio-visual alarm system shall be required at a minimum. Also refer to 10 CSR 20-8.140(8)(C).

(12) Supplement to the Summary of Design. The summary of design shall contain the following information in addition to that required in 10 CSR 20-8.110(5).

(A) Screening Devices. Provide the number of units, type, clear opening size, and the velocity at average design flow and peak hourly flow.

1. Fine screens. Provide the head loss across the fine screening device at a blinding factor of fifty percent (50%). Use of a lower blinding factor shall be justified.

(B) Comminutors.

(C) Grit Removal Facilities. Provide the number of units, type, and size. Provide the flow rate (average design flow and peak hourly flow). Provide the detention time during average design flow and peak hourly flow.

(D) Preaeration.

(E) Diurnal Flow Equalization.

(F) Wet Weather Flow Equalization.

(G) Grease Interceptors.

(H) Pump and Haul.

Comment [ETC21]: Is there anything additional that needs to be included from 8.110(5) (i.e. sizing, rates, velocities, diagrams, etc. for all individual process units)? If so, ideas of what to include?

AUTHORITY: section 644.026, RSMo Supp. 1988. Original rule filed Aug. 10, 1978, effective March 11, 1979.*

**Original authority 1972, amended 1973, 1987, 1993.*